

Mobile Payments

With a focus on IOT technologies for in-vehicle payment

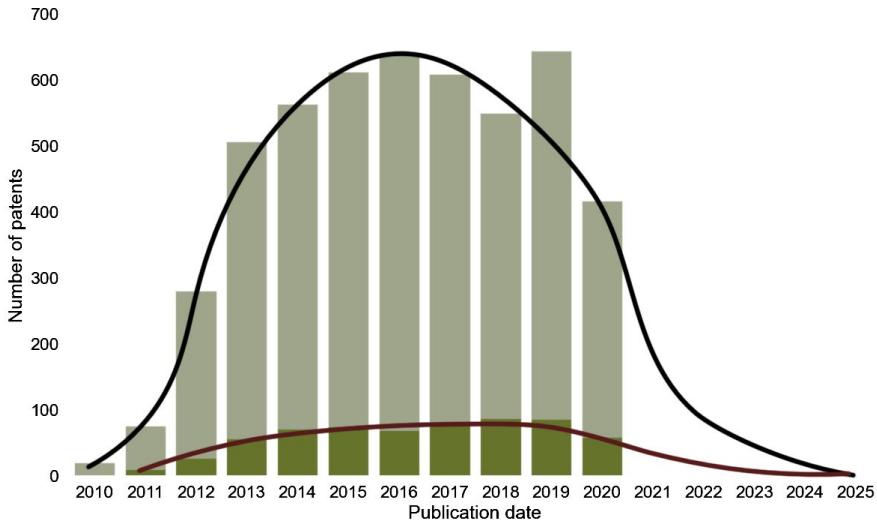




ABOUT THE PROJECT

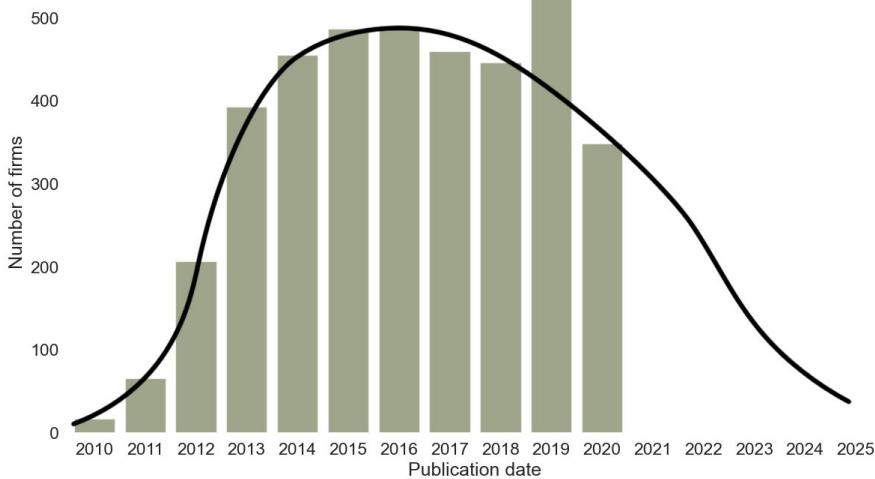
In-vehicle payment services crucially enable automobile drivers to purchase from their car dashboards without utilising smartphones or other devices: the vehicle will facilitate the payment itself. In this section we go deeper by analyzing the technologies competing in the in-vehicle payments: the embedded/IoT and the integrated systems.

Patents



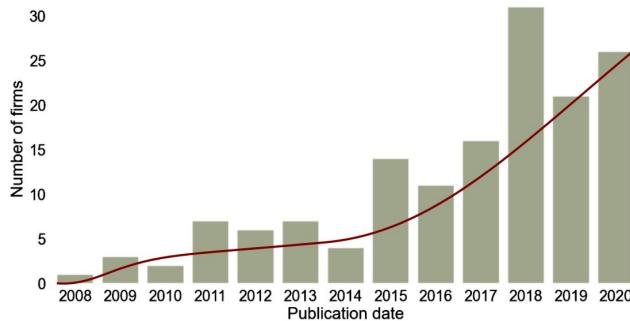
The curve on top represents the trend of the integrated system technology product patents in the last ten years, while that on the bottom follows the progress of the filled patens for the processes of that technology. We can see that we are in the maturity phase. In the part of the graph with no bars, predictions for the near future are represented.

Number of firms



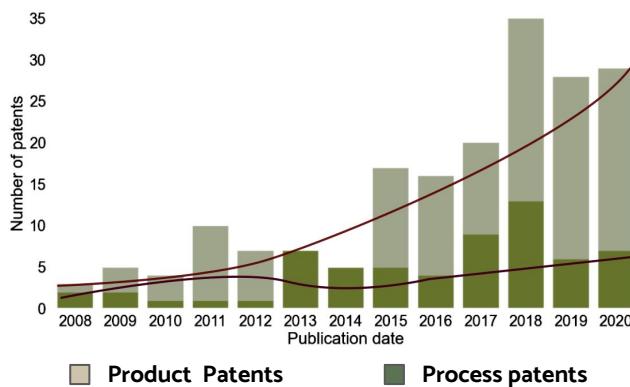
In this graph we grouped the number of firms related to the integrated system technologies in the last ten years. Also in this case we can see that we surpassed the fluid and transition phase and we are reaching the maturity one. In the part of the graph with no bars, predictions for the near future are represented.

Innovation Rate for Embedded Systems



Number of Firms over time

- We can see how the number of different firms filing patents started to grow significantly around 6 years ago and is still growing, probably in the next few years we will see even more companies involved.
- We are still in a phase where no stable architecture has emerged and this is an incentive for companies to enter the market.



Number of Patents over time

- The graph shows the number of product patents, overlapped with the number of process patents, over the last 12 years.
- We can see how the number of patent for the product is still growing and in the recent year changed significantly speed.
- Instead the number of production process patents are not showing a significantly strong increase. This could be expected since companies are not ready to invest on the production methods of an architecture that has not yet started to diffuse.

Knowledge Domains and Themes for embedded systems



Geographical distribution for the integrated systems

Continent	#Patents
Asia	2184
North America	1591
Europe	697
Oceania	40
South America	24
Africa	6

From this analysis we can conclude that these systems are predominant in Asia and North America. Regarding Asia, the Republic of Korea is taking the lead, while UK and Germany prevail in Europe.

Country	#Patents
United States	1451
Republic of Korea	1135
China	429
Japan	382
Taiwan	142
United Kingdom	128
Germany	105
Canada	94
France	57
Russia	57

Geographical distribution of embedded system Firms



- Most of the Firms are from Asia and North America, with Europe left behind.
- Companies from China filed the biggest number of patents but we couldn't find data on investments during our previous work, probably due to the severe restrictions on information that leave the country.
- South Korea, Japan and USA firms, as seen in the previous work, have made a lot of investments and in fact they have filed a big number of patents.

Knowledge Domains and Themes for integrated systems



The knowledge domains for these technologies is largely the same as for the embedded systems. One of the differences is that integrated systems might focus a little bit more on the software side and the embedded focuses more on the hardware side.

THE RELEVANT FEATURES

Alarm systems

They play a role in the recent 12 years but are still under development, for breaches and or malfunctions.

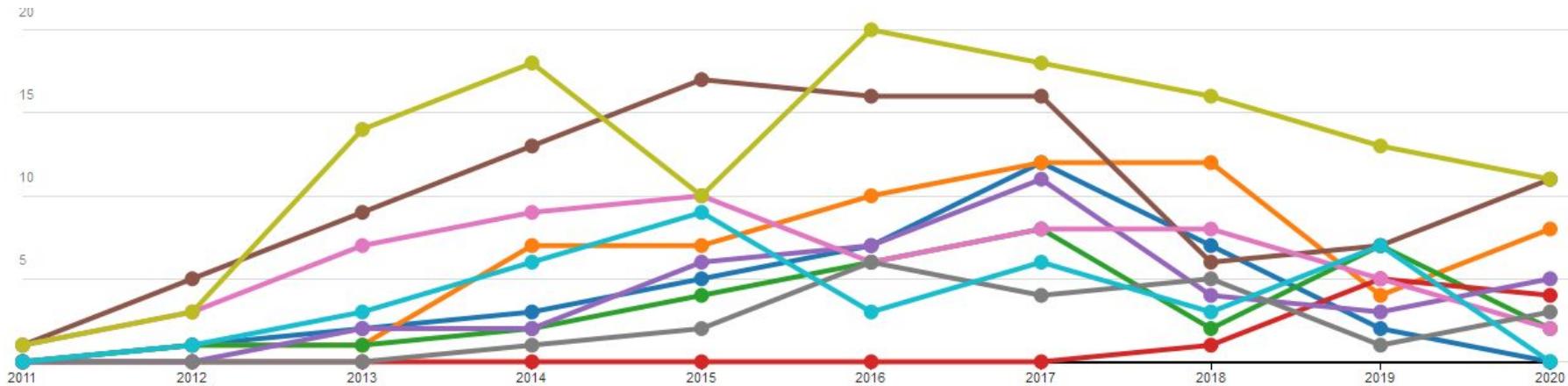
Data transmission systems

It involves networks and communication systems.

- It is deeply researched in the last few years.
- **Hot topic:** Biometric data are becoming more important for facial recognition, voice detection, digit prints classification. It affects security and the speed of process.

Biological models





■ G08B21/00 Alarms responsive to a single specified undesired or abnormal operating condition and not elsewhere provided for

■ G06Q20/00 Payment architectures

■ H04R1/00 Details of transducers

■ G08C17/00 Arrangements for transmitting signals characterised

■ G08B25/00 Alarm systems in which the location of the alarm condition is signalled to a central station

■ H04Q2209/00 Arrangements in telecontrol or telemetry systems

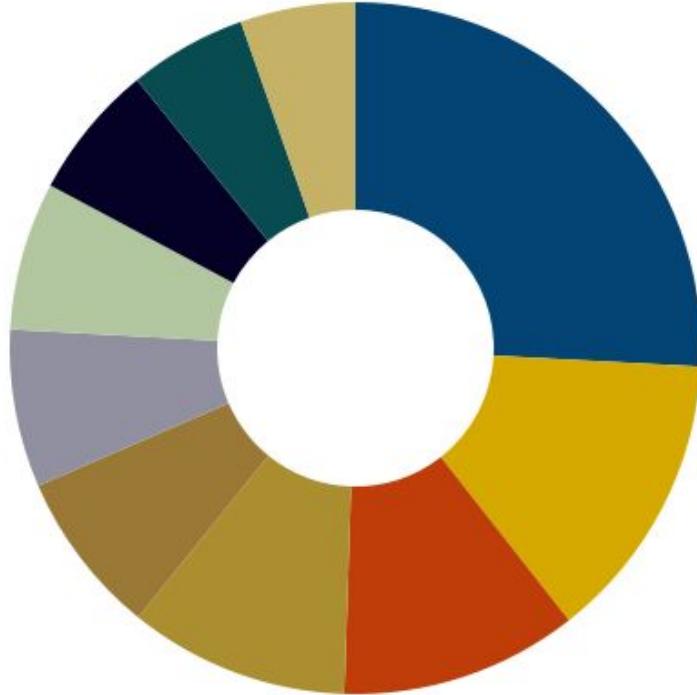
■ G06N3/00 Computer systems based on biological models

■ H04W84/00 Network topologies

■ H04R2420/00 Details of connection covered by H04R

■ H04B5/00 Near-field transmission systems

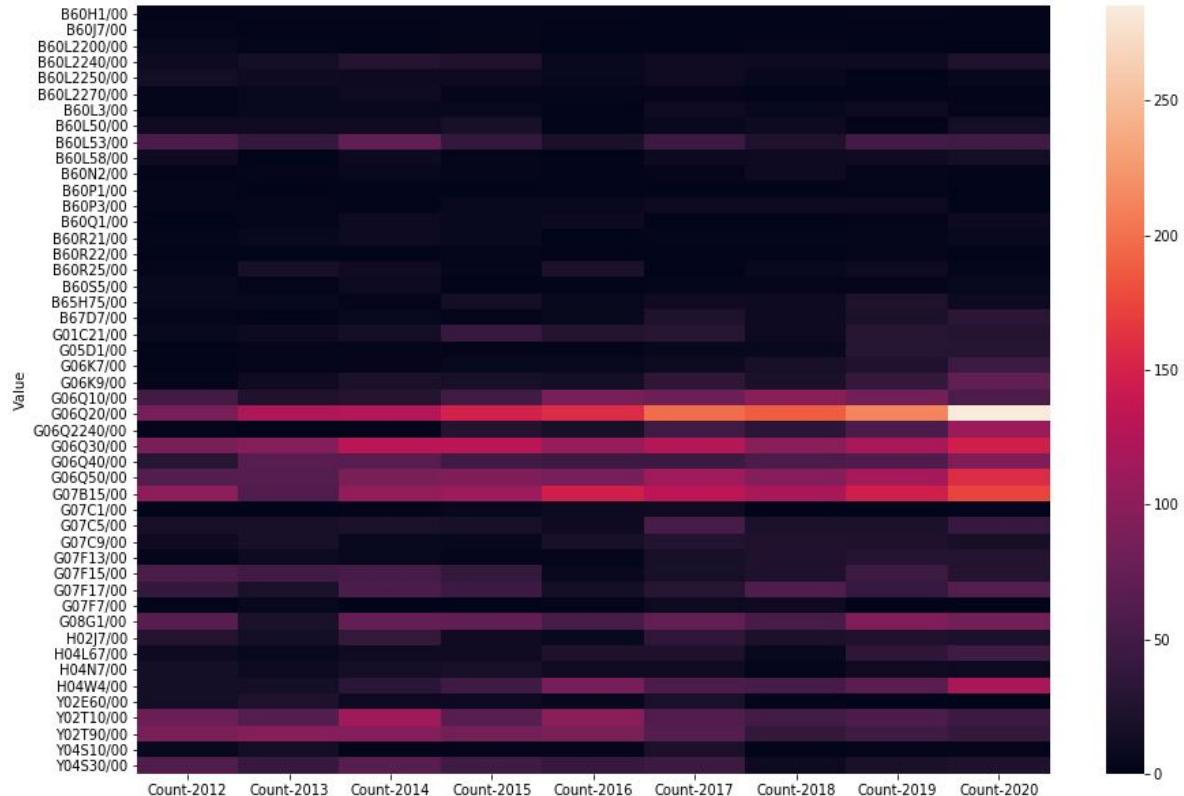
CPC growth



- H04M1/00 (831 patents, 26%) Substation equipment
- H04W4/00 (436 patents, 14%) Services specially adapted for wireless communication networks
- G06F3/00 (357 patents, 11%) Input arrangements for transferring data to be processed into a form capable of being handled by the computer
- H04L29/00 (331 patents, 10%) Arrangements
- G06Q50/00 (247 patents, 8%) Systems or methods specially adapted for specific business sectors
- A61B5/00 (237 patents, 7%) Measuring for diagnostic purposes
- H02J7/00 (223 patents, 7%) Circuit arrangements for charging or depolarising batteries or for supplying loads from batteries
- H04N5/00 (203 patents, 6%) Details of television systems
- H04B1/00 (177 patents, 6%) Details of transmission systems
- G06Q30/00 (173 patents, 5%) Commerce

The substation equipment growth suggests that the last year the **substation equipment** is the more exploited area for research, this means that the new directions for the new paradigm leads to an *IoT systems view*, and probably the Embedded systems will overcome the integrated ones actually in use.

CPC codes



G06Q10: Office automation

G06Q20: payment systems

G06Q30: e-Commerce

G06Q40: Finance; Insurance; Tax strategies; Processing of corporate or income taxes

G06Q2240: Transportation facility access, e.g. fares, tolls or parking

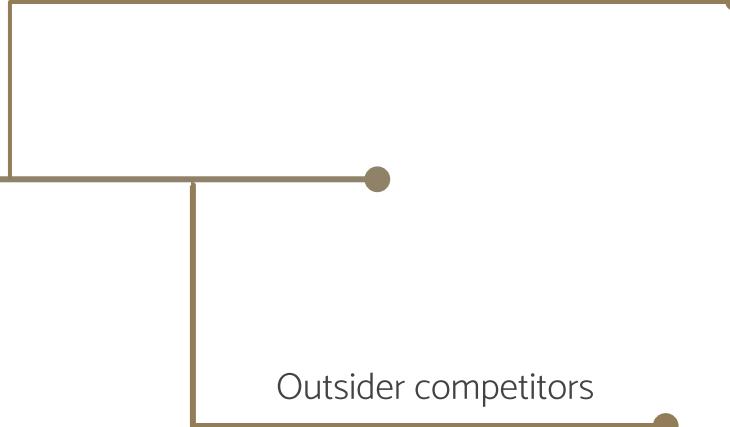
G07B15: Arrangements or apparatus for collecting fares, tolls or entrance fees at one or more control points

G08G1: Traffic control systems

H04W4: Services specially adapted for wireless communication networks; Facilities therefor



Emerging patterns



In the first part of our analysis, we've caught as competitors some corporations (GM & Shell, Visa & Sirius, Mastercard & Daimler). These different fields have a very strong synergy involving payment architectures, networking staff, artificial intelligence, automotive and electronics for embedded systems. In this second part of the analysis, we can conclude that other important fields, still not covered by these corporations, are the biological computer models to speed up the in vehicle payment process. Moreover, also investments on alarm systems may be involved for security both on technical problems and in case of theft or hacking's trial.

Outsider competitors

Tencent (one of major players of AI) bought 5% of Tesla. The autonomous vehicles could be an external competitor because they have similar competencies required and similar systems too.

MARKET CONCENTRATION



Embedded



Bluetooth



IoT



Integrated



NFC



AI

The various research present a patents' origins trend very clear. The sources are situated in U.S. and China. There are four main reasons:

- Technological infrastructure
- Law (e.g Privacy)
- Geographical and demographical structure / distribution & Cultural aspects
- Costs

Principal applications/solutions

In the following table we show some of the applications for our low level technology. Even if they differ for their environment, they all contribute to the core technology.

The most similar ones are those directly related to a kind of in-vehicle payment, while the remaining two exploit a similar low level architecture but for a different purpose. The solution regarding connected autonomous vehicles system, uses embedded and IoT systems in order to gather connected data, adjust and integrate autonomous decision for a safer driving experience. The solution regarding connected vehicle services, uses the same technology but for mobility management.



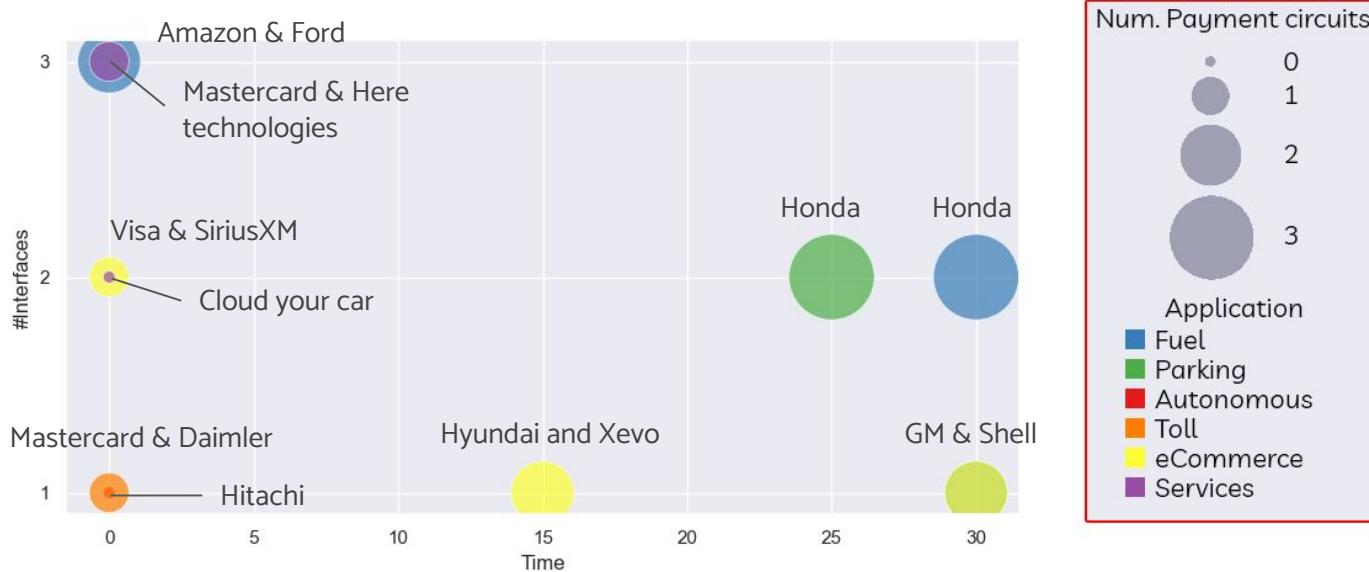
Principal applications/solutions

	Description	Company	Time taken	Interfaces	Payment circuits
In-vehicle fuel payment	Pay fuel through a dashboard app.	Honda	30s	<ul style="list-style-type: none">• Dashboard app• Voice command	<ul style="list-style-type: none">• Visa• MasterCard• PayPal
		General Motors & Shell	30s	<ul style="list-style-type: none">• Dashboard app	<ul style="list-style-type: none">• Infotainment screen, no credit card needed• Shell payment provider P97
		Amazon & Ford	Instant	<ul style="list-style-type: none">• Dashboard app• Voice command• Wearable tech	<ul style="list-style-type: none">• Visa• Mastercard
In-vehicle payment parking	Pay parking toll through a dashboard app.	Honda	25s	<ul style="list-style-type: none">• Dashboard app• Voice command	<ul style="list-style-type: none">• Visa• MasterCard• Paypal
Connected Autonomous vehicles systems	Integrate vehicle autonomy with connectivity data	Hitachi	Instant	<ul style="list-style-type: none">• Dashboard app	None

Principal applications/solutions

	Description	Company	Time taken	Interfaces	Payment circuits
In-vehicle automatic toll payment	Automatic toll collection	Mastercard & Daimler	Instant	<ul style="list-style-type: none">• Dashboard app	<ul style="list-style-type: none">• Mastercard
In-vehicle payment for eCommerce, foods and drinks	Allow drivers and their passengers to shop, pay for coffee, buy movie tickets, vehicle buy of drinks	Visa & SiriusXM	Instant	<ul style="list-style-type: none">• Dashboard app• Voice command	<ul style="list-style-type: none">• Visa
		General Motors & Shell	30s	<ul style="list-style-type: none">• Dashboard app	<ul style="list-style-type: none">• Infotainment screen no credit card needed• Shell payment provider P97
		Hyundai and Xevo	15s	<ul style="list-style-type: none">• Dashboard app	<ul style="list-style-type: none">• Visa• Mastercard
Connected vehicle services	Using data from connected vehicles for mobility management and safety and minimize operating expenses	Mastercard & Here technologies	Instant	<ul style="list-style-type: none">• Dashboard app• Smartphone• Wearable tech	<ul style="list-style-type: none">• Mastercard
		Cloud your car	Instant	<ul style="list-style-type: none">• Dashboard app• Smartphone	None

Principal applications/solutions



In the graph above, we compare different application through their variables. In this case, the price is not shown. We can see that in the same solution, we could have different parameters depending on the single company. For example, Mastercard pushes an instant system in two different solutions (toll and services). Honda maximises the number of payment circuits across different solutions (parking and fuel) but with a slower system. In the fuel application, Honda is overall better positioned than General Motors & Shell (in the graph, fuel and eCommerce are overlapped for GM & Shell) because it has more interfaces, more payment circuits and it is faster. These parameters may also depend on the core competences of the different companies, therefore, if different companies contribute to the same application, there will be different outcomes.

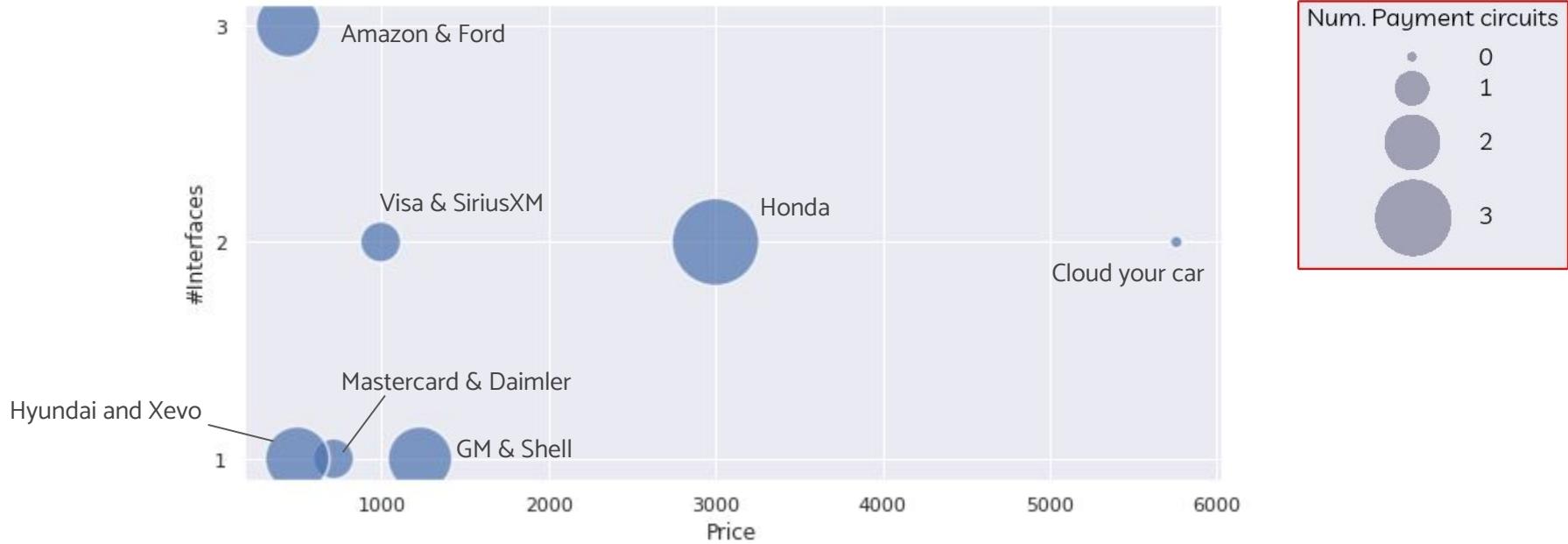
Price against other dimensions

*Some companies were omitted due to the lack of information

	Description	Company	Time taken	Interfaces	Payment circuits	Price
In-vehicle payment for eCommerce, foods and drinks	Allow drivers and their passengers to shop, pay for coffee, buy movie tickets, vehicle buy of drinks	Visa & SiriusXM	Instant	<ul style="list-style-type: none"> • Dashboard app • Voice command 	<ul style="list-style-type: none"> • Visa 	9€/month for all sirius xm connected car services. Hardware cost for installation is in 59-130 € range.
		General Motors & Shell	30s	<ul style="list-style-type: none"> • Dashboard app 	<ul style="list-style-type: none"> • Infotainment screen no credit card needed • Shell payment provider P97 	1230€ for enabling connected services
		Hyundai and Xevo	15s	<ul style="list-style-type: none"> • Dashboard app 	<ul style="list-style-type: none"> • Visa • Mastercard 	3 years of connected car services for free + 99€/year for each service. Hardware cost hide in premium connectivity package (1150€)

	Description	Company	Time taken	Interfaces	Payment circuits	Price
In-vehicle fuel payment	Pay fuel through a dashboard app.	Honda	30s	<ul style="list-style-type: none">• Dashboard app• Voice command	<ul style="list-style-type: none">• Visa• MasterCard• PayPal	3000€ for Honda advance (which includes connectivity services)
		Amazon & Ford	Instant	<ul style="list-style-type: none">• Dashboard app• Voice command• Wearable tech	<ul style="list-style-type: none">• Visa• Mastercard	440€ for connectivity services
Connected vehicle services	Using data from connected vehicles for mobility management and safety and minimize operating expenses	Cloud your car	Instant	<ul style="list-style-type: none">• Dashboard app• Smartphone	None	60€ for 30 days + hardware cost
In-vehicle automatic toll payment	Automatic toll collection	Mastercard & Daimler	Instant	<ul style="list-style-type: none">• Dashboard app	<ul style="list-style-type: none">• Mastercard	89€ a year(price for connected car services) Hardware usually included in the car price(luxury cars)

Price Comparison



In this graph we compare the solutions over price in euros for 8 years of use, number of interfaces and number of payment circuits. The prices are subscription prices for general connected car services already available in the market in which we think the in-vehicle payment service will be embedded or is already present as in Daimler's Mercedes Pay.

It's quite evident that the market will favor those services with a high number of interfaces and a cheaper price. In this chart Amazon & Ford seem to have the competitive advantage.

It must be taken into account that for some car companies the price of the service is embedded into the price of the car itself. For example Hyundai gives 3 years of service for free with each new car.

The previous points suggest that the availability of the system is restricted to high income users, a possible but difficult offer could consider the mass market with a revenue based more on users data and advertising rather than fees.



AD Based

Requirements:

The system should take advantage from data, which are not enough to cover the costs, so there should be additional and parallel services that could expand the service itself and get more data.

PEER TO PEER

Involve the opportunity to perform car to car (peer to peer) payments through some additional device or feature.



Requirements:

The system should create a network or a protocol able to connect and perform secure payments between 2 cars.

HOLES



Requirements: Decrease production costs distributing the technology on an higher amount of cars, mass market production, data and ad exploitation.

Strategy: Cost Leadership at the beginning, differentiation if other players can enter the market.

INNOVATION STRATEGY

Requirements: The cost is already coherent towards the premium market, what moves the needle is the differentiation. Rather than focusing on cost, security and performances should be prioritized along additional and optional services.

Strategy: Differentiation.

Thank You!